

PATENT SPECIFICATION

(11) 1284755

1284755

NO DRAWINGS

- (21) Application No. 45957/69 (22) Filed 18 Sept. 1969
 (31) Convention Application No. 763972 (32) Filed 30 Sept. 1968 in
 (33) United States of America (US)
 (45) Complete Specification published 9 Aug. 1972
 (51) International Classification B44D 1/14// C09D 3/14 3/52 3/74
 C08G 37/30



(52) Index at acceptance

- B2E 185 18Y 190 191 192 193 197 19X 19Y 204 209
 20Y 228 23Y 327 349 360 380 381 382 386
 38X 38Y 390 391 392 393 394 39X 39Y 401
 402 40X 40Y 410 413 414 416 41X 41Y 420
 44Y 498 505 50Y 532 565 568 56Y 65Y 676
 67Y 708 742 743 755 756 758 772 773 774
 775 776 777 778 77Y 78Y 799
 C3F 37Y 38Y 391 39Y 500 51Y 531 626 641 642 720
 721
 C3P 7C10 7C13A 7C14B 7C20B 7C20C 7C20D1 7C6A
 7C6B 7C8A 7C8B 7C8C 7C9 7D2A1 7D8 7K8
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 C3R 29C1 29C12 29C14A 29C14B 29C25 29C2A 29C4
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 29L1B 29L2X 29L6G

(54) PROCESS FOR COATING SURFACES AND COMPOSITIONS FOR USE THEREIN

(71) We, CELANESE COATINGS COMPANY, a corporation organised and existing under the laws of the State of Delaware, United States of America, of Federal Land Bank Building, 224 East Broadway, Louisville, Kentucky, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the application of protective and decorative coatings to surfaces, especially to the surfaces of automobiles, and to coating compositions used therefor.

Acrylic resins have found wide application as the basis of coating compositions especially in the automobile industry where two coating systems are employed. In one system a lacquer consisting of a thermoplastic acrylic polymer in organic solvent solution is used and produces a top coat which can be finished in a wide range of colours to a very high gloss but which has disadvantages, in particular a poor chemical resistance and a tendency to exhibit cracking and crazing. In the other system a thermosetting acrylic resin is used and the coating, after curing, shows high chemical resistance and little or no

tendency to cracking or crazing; however, the coatings produced do not possess the aesthetic properties which are exhibited by coatings which can be produced with a lacquer.

Coating compositions are known which contain as film formers both an acrylic polymer and a cellulose ester, including cellulose acetate butyrate. The present invention is concerned with a method of coating surfaces, using such a composition to form an undercoating, which enables coatings to be obtained possessing both high chemical resistance and little or no tendency to cracking or crazing and also aesthetic properties such as have previously been regarded as obtainable only with lacquers based on thermoplastic resins. The process is of especial value in the automobile industry since it is very effective in producing the popular metallic finishes using compositions containing metallic pigments.

According to the invention the application of a protective and decorative coating to a surface is effected by a process which comprises applying thereto an undercoating composition comprising film formers which include both an acrylic polymer and a cellulose ester, the latter forming from 2 to 50 weight per cent of the total film formers, one or more pigments and a volatile organic solvent medium for the film formers, drying the com-

position on the surface without baking the undercoating thus formed, forming on the undercoating a transparent top coating from a composition comprising a copolymer of

- 5 (a) from 0.15 to 8 weight per cent of acrylic acid, itaconic acid, methacrylic acid, crotonic acid or a half ester of maleic or fumaric acid with a saturated alcohol containing 1 to 10 carbon atoms, or of more than one of these compounds, with
- 10 (b) from 5 to 75 weight per cent of a beta hydroxyalkyl ester of any one of the compounds listed in (a) and
- 15 (c) from 17 to 94.85 weight per cent of one or more ethylenically unsaturated monomers other than the compounds of (a) and (b),

20 the total of (a), (b) and (c) being 100 weight per cent, a cross-linking agent for said copolymer and a volatile solvent medium for said copolymer, and heating the coated surface to from 180° to 400°F for a period sufficient to cure the transparent top coating.

25 An important aspect of the invention is the constitution of the composition used in depositing the undercoating which is formulated so as to provide a film which will not intermix with or dissolve in the subsequently applied top coating and hence will not allow the pigments to migrate from the undercoating to the top coating. Nevertheless the dry undercoating is wet by the composition used to form the top coating which adheres strongly to the undercoating. To achieve the desired result rapid removal of solvent from the composition forming the undercoating is important and the cellulose ester present in the composition facilitates the quick release of the volatile organic solvent medium. The application of the composition by spraying is preferred since in this way the rapid removal of solvent vapour, even at normal temperature and pressure, can be achieved and the formation of an unduly thick film liable to hold solvent avoided.

35 The cellulose ester used in making the composition forming the undercoating may be, for instance, cellulose nitrate, cellulose propionate, cellulose butyrate, cellulose acetate butyrate or cellulose acetate propionate or mixtures of such esters, the preferred cellulose ester being cellulose acetate butyrate. The cellulose ester preferably forms from 5 to 20 per cent of the weight of the film forming solids in the composition. The viscosity of the cellulose ester can range from 0.1 to 2 seconds (ASTM Method D-1343-54T).

60 The pigments which may be used include metallic pigments, e.g. aluminium or copper bronze, iron blues, organic reds, maroons, silica, talc, china clay and metal oxides,

chromates, sulphides and silicates. The pigments are used in the proportions commonly used in coating compositions to obtain the proper opacity in films having, for instance, a dry thickness of from 0.5 mils to 3 mils, preferably from 0.6 to 1.5 mils. The pigment particles can be regular or irregular geometric figures and their sizes can, in general, vary from 44 microns to 5 microns and are preferably in the range of from 5 to 20 microns.

70 The acrylic polymer in the undercoating composition may be a methyl methacrylate homopolymer or copolymer, examples of these polymers of the type used in lacquers being methyl methacrylate homopolymers and copolymers of 55,000 to 105,000 molecular weight, the copolymers being made from methyl methacrylate with 2 to 25 weight per cent of acrylic or methacrylic acid or a C₁ to C₄ ester thereof or vinyl acetate, acrylonitrile or styrene, or of the thermosetting type, e.g. a polymer in which a copolymer of acrylic acid, methacrylic acid or crotonic acid, or a hydroxy ester of such an acid, with another ethylenically unsaturated monomer forms a cross-linking agent with a di-isocyanate, an epoxide or an aminoplast, such as are described in our United States Patent No. 3,375,227. Preferably the same type of acrylic polymer is used in both the undercoating and the top coating compositions, although it will be understood that, in this case, cross-linking is not allowed to occur in the undercoating before the top coating is applied. In making such a copolymer the ethylenically unsaturated monomer (c) may be, for instance, a vinyl aromatic compound having a single vinyl group and free of other substituents capable of reacting with an unsaturated acid, e.g. styrene, vinyl toluene, isopropenyl toluene, a dialkyl styrene, ortho-, meta- or parachloro styrene, a bromo, fluoro or cyano styrene, vinyl naphthalene, the various alpha-substituted styrenes, e.g. alpha methyl styrene, alpha methyl para-methyl styrene, as well as various di-, tri- and tetra-chloro, bromo and fluoro styrenes. Other ethylenically unsaturated comonomers which may be used include acrylic, methacrylic and crotonic esters of saturated alcohols, e.g. of methyl, ethyl, propyl, isopropyl, n-butyl, iso-butyl, (sec) butyl, (tert) butyl, amyl, hexyl, heptyl, octyl, decyl and dodecyl alcohols. The preferred comonomers (c) include alpha beta ethylenically unsaturated monocarboxylic acid esters of saturated monohydric alcohols, the acids having not more than four carbon atoms and the alcohols having not more than twenty carbon atoms, and mono-vinyl aromatic compounds. Other vinyl monomers can, however, be used e.g., vinyl aliphatic cyanides of not more than four carbon atoms, for example, acrylonitrile and methacrylonitrile, monovinyl ethers, e.g., ethyl vinyl ether, ethyl methallyl

ether, vinyl butyl ether, methyl vinyl ether and others of not over twenty carbon atoms, and unsaturated monohydric alcohol esters of saturated monobasic acids, wherein the alcohols contain a single vinyl group and the acids have not more than twenty carbon atoms, for instance, vinyl acetate, vinyl stearate, and the allyl, methallyl, and crotyl esters of propionic, butyric and other acids.

Mixtures of the vinyl monomers can be copolymerised with the alpha beta unsaturated acids and hydroxyalkyl ester monomers to form the carboxylic containing vinyl copolymer. A particularly desirable mixture for monomer (c) is a combination of an acrylic or methacrylic ester with styrene or vinyl toluene.

Typical of the beta hydroxyl alkyl esters used as monomer (b) in the copolymers are 2-hydroxy propyl methacrylate and 2-hydroxy propyl acrylate.

Among the catalysts which may be used for promoting the polymerisation of the alpha beta ethylenically unsaturated monocarboxylic acid with the monomers (b) and (c) are hydrogen peroxide, various organic peroxides, for example, ascaridol, acetyl and benzoyl peroxides, dibutyl and dilauryl peroxides, caprylyl peroxide, as well as partially oxidized aldehydes which can contain peroxides, urea peroxide, succinic acid peroxide, fatty acid peroxides, e.g., coconut oil peroxides, stearic peroxide, lauric peroxide, and oleic peroxide, alcoholic peroxides, e.g., tertiary butyl hydroperoxide, and other peroxides such as cumene hydroperoxide, tertiary butyl perbenzoate, hydroxyheptyl peroxide and chlorobenzoyl peroxide. Other free radical promoting catalysts such as azobisisobutyronitrile can also be used. The relative viscosity of the film forming polymers in the coating compositions can range from 1.05 to 1.20, the relative viscosity being the quotient obtained by dividing the efflux time of a solution of 0.25 gram of the polymer in 50 millimetres of ethylene dichloride by the efflux time of ethylene dichloride, the efflux times being measured in accordance with the procedure of A.S.T.M. D-445-46T, method B at 25°C. using a modified Ostwald viscosimeter, series 50.

The presence of the carboxyl groups in the copolymer is of particular importance in that these carboxyl groups impart to the copolymer a unique compatibility with the cross-linking agent, such as an alkylated aminoplast resin, and consequently these copolymers produce a cross-linked product having a very high gloss. On the other hand, the absence of the carboxyl groups results in the production of cross-linked products having substantially less gloss.

The presence of the carboxyl groups in the copolymer is also of significance in imparting stability to the copolymer when the

copolymer is present in an uncured mixture containing the cross-linking agent, such as a diisocyanate. This stability feature is important because these copolymers are generally sold in admixture with the cross-linking agent. It is therefore of paramount importance that no substantial cross-linking reaction take place between the copolymer and the cross-linking agent during the shipping and storage periods.

When used with a cross-linking agent such as an alkylated aminoplast resin the copolymers require no additional acid catalyst and yet they are surprisingly stable when present in an uncured mixture containing the cross-linking agent. If the stability of the mixture is not of primary concern, small amounts of acid catalysts may sometimes be added to the mixture.

The cross-linking agent used may be, for instance, a diisocyanate, an epoxide or an aminoplast resin. Suitable aminoplast resins include alkylated derivatives of condensates formed by the reaction of amino-triazines and amino-diazines with aldehydes. It is known that various amines and amides will condense with aldehydes in the presence of alcohols to form alkylated aldehyde-amine and aldehydeamide condensates. Thus, urea, thiourea, and various substituted ureas and urea derivatives will react with aldehydes such as formaldehyde to form condensates, e.g., methylol ureas. Similarly, it is well known that melamines such as melamine itself and benzoguanamine will react with aldehydes, particularly formaldehyde, to form melamine-aldehyde condensates. Various other amines and amides can similarly be reacted with an aldehyde, e.g. formaldehyde, to form condensates which are amine aldehyde or amide aldehyde resins or condensates. Alkylated condensates result when the amino aldehyde or amide aldehyde resin is prepared in the presence of alcohols such as methyl, ethyl, propyl, butyl, isobutyl, octyl and decyl alcohol, the alcohol becoming a part of the resulting product. In general, alkylated urea or melamine aldehyde condensates of different degrees of condensation can be used so long as they are soluble in aromatic hydrocarbons or mixtures of these with other solvents. Alkylated melamine-aldehyde condensates are, however, the preferred aminoplast resins.

The proportions of the acrylic copolymer and the cross-linking agent depend on the desired properties of the finished transparent coating which results on curing at from 180°F. to 400°F. It is usually preferred that the polymer composition contains 5 to 50 weight per cent of cross-linking agent and, especially, from 20 to 40 weight per cent based on the film forming material.

Examples of the volatile solvents which can be used in formulating the coating compositions used in the process of the invention

are toluene, xylene, butyl acetate, acetone, methyl isobutyl ketone, butyl alcohol, and other aliphatic, cycloaliphatic and aromatic hydrocarbons, esters, ethers, ketones, and alcohols such as are conventionally used in coating compositions. The criteria for the selection of the solvent medium is that it will not react with the film forming material and can readily be removed by evaporation in the application and curing process. The amount of solvent is controlled to provide the coating composition with the ability to flow or level out to a smooth surface while ensuring a viscosity satisfactory for the method of application adopted.

The coating compositions can be applied by brushing, spraying, dipping, flow-coating or other method but, as already stated, it is preferred, that the technique of spraying of the compositions be used especially since very smooth coatings are thus obtained. Various methods of spraying can be utilized, e.g. compressed air spraying, electrostatic spraying, hot-spraying techniques or airless spraying, and the processes can be operated by hand or machine. The coatings may, in general, be of 0.5 to 2 mils thickness but it is preferred to form an undercoating 0.6 to 1.5 mils thick (dry basis) and a top coating 0.8 to 1.3 mils thick (dry basis).

The undercoating composition can be applied directly to a bare substrate, on a treated substrate or on a primed (e.g. for corrosion resistance) substrate. The invention is of particular importance in the coating of steel surfaces but other substrates can be similarly treated providing they are not adversely affected by baking operations, e.g. glass, ceramics, asbestos, wood and plastics (when moderate baking temperatures are permissible) and metals such as aluminium, copper, magnesium and alloys thereof. After application of both coatings curing is effected, as stated, at 180° to 400°F., the preferred temperature range being from 225° to 280°F.

It is preferred that the transparent top coating be substantially colourless so that the colour of the undercoating is not noticeably decreased. However, in some instances, desirable styling effects can be obtained by the addition of contrasting or complementary colours to the transparent coating. The durability provided by the top coating makes it possible to use in the undercoating pigments heretofore considered unsatisfactory because of their poor durability properties.

The following Examples, in which parts and percentages are by weight, illustrate the invention; the acrylic polymer solutions used in the Examples were prepared as follows (the parts and percentages given here also being by weight):—

Acrylic Polymer Solution A

To a reactor equipped with a thermometer,

stirrer, reflux condenser and dropping funnel were added a solvent medium consisting of 166 parts of n-butanol, 287 parts of toluene and 1507 parts of ethylene glycol monoethyl ether acetate. To the dropping funnel was added a mixture of 868 parts of n-butyl methacrylate, 812 parts of methyl methacrylate, 32.8 parts of methacrylic acid, 287.2 parts of 2-hydroxypropyl methacrylate and 40 parts of cumene hydroperoxide. Heat and agitation were applied to the reactor and, when the temperature of the solvent medium reached 277°F., addition of the monomer-catalyst mixture was begun and continued over a 45 minute period while holding the temperature between 262°F. and 277°F. After two hours additional heating at 277°F. the Gardner-Holdt viscosity at 25°C. of a check cut of the solution reduced to 30% solids with ethylene glycol monoethyl ether acetate was K—L. With two hours further heating at 277°F. to 278°F. the viscosity (at 30% solids) was P—Q and after 2 hours and 5 minutes more it was Q—R. Heating was discontinued and the polymer solution was filtered. The resulting solution had a Gardner-Holdt viscosity of Z₃—Z₄, at 25°C. and at 39.9% solids in the solvent medium used in the polymerisation (84.91% ethylene glycol monoethyl ether acetate, 5.53% n-butanol and 9.56% toluene), a weight per gallon of 8.42 pounds, an acid value on solids basis of 17.2, and a Gardner colour of 1. The relative viscosity of the copolymer was 1.1434.

Acrylic Polymer Solution B

Using the procedure described for making acrylic polymer solution A, 938 parts of n-butyl methacrylate, 878.4 parts of methyl methacrylate, 39.4 parts of methacrylic acid and 144.2 parts of 2-hydroxypropyl methacrylate were polymerised in a solvent medium consisting of 166 parts of n-butanol, 287 parts of toluene and 835 parts of ethylene glycol monoethyl ether acetate using 45 parts of cumene hydroperoxide as polymerisation catalyst. The resulting copolymer solution at 40% non-volatiles had a weight per gallon of 8.4 pounds, an acid value of 21.2 on solids basis, a Gardner colour of less than 1 and a Gardner-Holdt viscosity at 25°C. of Z₄—Z₅. The relative viscosity of the copolymer was 1.1778.

Acrylic Polymer Solution C

Using the procedure described for making acrylic polymer solution A, 938 parts of n-butyl methacrylate, 878.4 parts of methyl methacrylate, 39.4 parts of methacrylic acid and 144.2 parts of 2-hydroxypropyl methacrylate were polymerised in a solvent medium consisting of 166 parts of n-butanol, 287 parts of toluene and 1507 parts of ethylene glycol monoethyl ether acetate using 120

parts of cumene hydroperoxide as catalyst. The resulting copolymer solution when adjusted to 39% non-volatiles had a weight per gallon of 8.27 pounds, an acid value on solids basis of 18.4, a Gardner colour of less than 1, and a Gardner-Holdt viscosity at 25°C. of T—U. The relative viscosity of the copolymer was 1.0779.

Acrylic Polymer Solution D

- 10 Using the procedure described for making acrylic polymer solution A, 20 parts of n-butyl methacrylate, 30 parts of styrene, 20.3 parts of 2-hydroxypropyl methacrylate, 1.7 parts of methacrylic acid and 28 parts of n-butyl acrylate were copolymerised in a solvent medium consisting of 85 parts of xylene and 15 parts of n-butanol using 4 parts of cumene hydroperoxide. The resulting copolymer solution at 40% non-volatiles had a Gardner-Holdt viscosity of G—H and an acid value on solids basis of 14 to 16.

Acrylic Polymer Solution E

- 25 Using the procedure described for making acrylic polymer solution A, a copolymer of 47 parts of n-butyl methacrylate, 37 parts of styrene, 15.75 parts of 2-hydroxypropyl methacrylate and 0.25 part of methacrylic acid was prepared in a solvent medium consisting of 85 parts of xylene and 15 parts of n-butanol. At 45% non-volatiles the Gardner-Holdt viscosity of the polymer solution at 25°C. was P—Q. The acid value on a solids basis was 10.

EXAMPLE 1

- 35 A pigment base was prepared by blending 11.76 parts of aluminium pigment paste, 0.26 part of low opacity yellow iron oxide pigment paste, 0.56 part of carbon black pigment paste and 1.70 parts of phthalocyanine blue pigment paste.

- 40 The aluminium pigment paste was made by mixing 30.78 parts of aluminium pigment made from 65 weight percent aluminium flakes coated with stearic acid and dispersed in mineral spirits, 14.22 parts of xylene and 55 parts of a butylated methylol melamine resin solution at 60% non-volatiles in xylene and n-butanol, having a Gardner-Holdt viscosity at 25°C. of O—R, an acid value of 0.2—1.0 and a naphtha tolerance of 200 to 350.

- 50 The iron oxide pigment paste was prepared from a sand grind of 30.25 parts of low opacity yellow iron oxide, 52.40 parts of the acrylic polymer solution D at 45% non-volatiles and 17.35 parts of an aliphatic hydrocarbon solvent.

- 60 The carbon black pigment paste was made from a sand grind of 27.60 parts of the butylated methylol melamine resin solution described above, 15.78 parts of n-butanol and 5.91 parts of carbon black.

The phthalocyanine blue pigment paste was prepared by sand grinding 74.67 parts of the butylated methylol melamine resin solution described above with 10.13 parts of phthalocyanine blue and 15.2 parts of an aliphatic hydrocarbon solvent.

14.28 parts of the pigment base were blended with 1.52 parts of the butylated methylol melamine resin solution described above, 9.75 parts of acetone and 3.24 parts of cellulose acetate butyrate, having a viscosity of 1 to 2 seconds (ASTM Method D-1343-54T) a butyryl content of 50%, an acetyl content of 2.8% and a hydroxyl content of 2.0%, dissolved in 4.86 parts of acetone, 5.67 parts of toluene and 3.24 parts of ethylene glycol monoethyl ether acetate. After thorough mixing the product was reduced to 14 seconds viscosity, as determined by a No. 4 Ford cup, with approximately 100 parts of toluene to obtain an undercoat paint.

To form a top coat paint 144 parts of the acrylic polymer solution A, at 45% non-volatiles, was blended with 58 parts of the butylated methylol melamine resin solution described. The blend was reduced to 40% non-volatiles with xylene, producing a transparent coating composition having a viscosity of 28 to 32 seconds as measured by a No. 4 Ford cup. Pine oil, 5 parts, and approximately 50 parts of xylene were then added to reduce the viscosity to 17 seconds.

"Bonderized" (Registered Trade Mark) steel panels primed with a cured corrosion resistant primer were sprayed with the undercoat paint to a film thickness of 0.5 mil on dry film basis. After a flash of approximately 2 minutes at room temperature an additional 0.5 mil film of the paint, again as measured on a dry film basis, was applied by spraying. After a two minute flash at room temperature, the transparent top coat paint described above was applied by spraying to a film thickness on dry basis of 1 mil. After a 2 to 5 minute flash period at room temperature the coated panel was baked at 250°F. for 30 minutes. The resulting coating, having a silver metallic appearance, had excellent gloss as evidenced by a reflectance of 80 to 95% on a 20° Gardner glossmeter. The coating exhibited excellent polychromatic properties with uniformity of the aluminium particle orientation. The coating had excellent acid resistance, a spot of 5% sulphuric acid on the painted surface, when evaporated to dryness, failing to mar the film. The outdoor exposure durability was excellent with little dulling after 18 months exposure.

EXAMPLE 2

According to the procedure described in Example 1, two silver-like undercoat paints were prepared using the same components

in the same proportions except that acrylic polymer solutions B and C were respectively substituted for the polymer solution D used in Example 1. When these paints were

- 5 sprayed on primed "Bonderized" steel panels, top coated and baked, in the manner described in Example 1, excellent coatings with outstanding durability and aesthetic appearance were obtained.

EXAMPLE 3

To a container equipped with a mechanical agitator were added the following substances:—

- 15 54.05 parts of a 40% solution of an acrylic copolymer made from 97% methyl methacrylate and 3% methacrylic acid in a mixture of 92% toluene and 8% acetone. The copolymer solution had a Gardner-Holdt viscosity of Z_3 to Z_4 and an acid value of 19.9 on solids basis. The acrylic copolymer had a relative viscosity of 1.1172;

- 20 24.48 parts of a 20% solution of cellulose acetate butyrate in a mixture of 37.5% acetone, 43.75% toluene and 18.75% ethylene glycol monoethyl ether acetate. The cellulose acetate butyrate had a butyryl content of 37%, an acetyl content of 13%, a hydroxyl content of 2% and a viscosity of 2 seconds as determined by ASTM Method D-1343-54T;

- 30 6.85 parts of butyl benzyl phthalate, as plasticizer;

- 35 6.28 parts of a dispersion of 20% aluminium flakes, 11% butyl benzyl phthalate, 7% cellulose acetate butyrate as described above, 31% ethylene glycol monoethyl ether acetate and 31% toluene;

- 40 0.72 parts of a dispersion of 13% phthalocyanine blue pigment, 17.5% butyl benzyl phthalate, 7.5% cellulose acetate butyrate, 31% ethylene glycol monoethyl ether acetate and 31% toluene;

- 45 0.14 parts of a dispersion of 45% titanium dioxide, 6% cellulose acetate butyrate, 24.5% ethylene glycol monoethyl ether acetate and 24.5% toluene;

- 50 0.1 part of a dispersion of 18% organic red pigment, 17.5% butyl benzyl phthalate, 7.5% cellulose acetate butyrate, 28.5% ethylene glycol monoethyl ether acetate and 28.5% toluene; and

8.71 parts of acetone.

These components were thoroughly blended to make an undercoat paint.

- 55 Primed "Bonderized" steel panels were sprayed with the undercoat paint to a film thickness of 0.5 mil on dry film basis. After a flash time of 2 minutes at room temperature an additional 0.5 mil, on dry film basis, of the undercoat paint was applied by spraying. Allowing 2 to 5 minutes flash time at room temperature, the transparent top coat paint described in Example 1 was applied by spraying to a dry film thickness of 1 mil.

After baking for 30 minutes at 250°F., light blue metallic coatings having excellent gloss and outstanding aesthetic and durability properties were obtained.

EXAMPLE 4

A transparent top coat paint was prepared by blending 144 parts of the acrylic polymer solution E at 45% non-volatiles with 58 parts of the 60% non-volatile solution of butylated methylol melamine described in Example 1. This top coat paint was applied by spraying to a dry film thickness of 1 mil over the undercoat described in Example 1 applied to a metal substrate as described in that Example. After a 2 to 5 minute flash time at room temperature, the coating was baked at 190°F. for 15 minutes. The coating was then sanded with very fine sand paper and water to smooth the coating and to remove surface imperfections. After rinsing with mineral spirits, the coating was baked at 250°F. for 30 minutes. The resulting coating had reflowed before curing, the sanding marks had disappeared and the final coating had a pleasing polychromatic effect.

It will be seen that, in Examples 1, 2 and 4, a solution of a butylated methylol melamine resin is used in making the undercoating compositions described but, as those compositions are only flash dried, the resin merely acts as additional film former and no cross-linking occurs at least until the baking operation which follows application of the top coating.

WHAT WE CLAIM IS:—

1. Process for the application of a protective and decorative coating to a surface which comprises, applying thereto an undercoating composition comprising film formers which include both an acrylic polymer and a cellulose ester, the latter forming from 2 to 50 weight per cent of the total film formers, one or more pigments and a volatile organic solvent medium for the film formers, drying the composition on the surface without baking the undercoating thus formed, forming on the undercoating a transparent top coating from a composition comprising a copolymer of

- (a) from 0.15 to 8 weight per cent of acrylic acid, itaconic acid, methacrylic acid, crotonic acid or a half ester of maleic or fumaric acid with a saturated alcohol containing 1 to 10 carbon atoms, or of more than one of these compounds, with
- (b) from 5 to 75 weight per cent of a beta hydroxyalkyl ester of any one of the compounds listed in (a) and
- (c) from 17 to 94.85 weight per cent of one or more ethylenically unsaturated

monomers other than the compounds of (a) and (b),

- the total of (a), (b) and (c) being 100 weight per cent, a cross-linking agent for said copolymer and a volatile solvent medium for said copolymer, and heating the coated surface to from 180° to 400°F for a period sufficient to cure the transparent top coating.
- 5 2. Process according to Claim 1, wherein
- 10 the undercoating is formed from a composition containing, as the acrylic polymer, the copolymer of (a), (b) and (c) present in the composition used in forming the top coating.
- 15 3. Process according to Claim 1 or 2, wherein the undercoating is formed from a composition containing, as the acrylic polymer, a polymer or copolymer of methyl methacrylate and, as the cellulose ester, cellulose acetate butyrate.
- 20 4. Process according to Claim 1, 2 or 3, wherein the undercoating has a dry thickness of from 0.6 to 1.5 mils and the top coating

has a dry thickness of from 0.8 to 1.3 mils.

5. Process according to Claim 1, 2, 3 or 4, wherein the composition used for forming the undercoating contains a metallic pigment. 25

6. Process according to any of the preceding claims, wherein component (c) used in making the copolymer comprises a combination of an acrylic or methacrylic ester with styrene or vinyl toluene. 30

7. Process for the application of a protective and decorative coating to a surface according to Claim 1 and substantially as described. 35

8. Articles having a surface coating applied by the process claimed in any of the preceding claims.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1972.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.